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IMPACT OF THE SEAM ANGLES ON THE DRAPE BEHAVIOUR OF TEXTILE FABRICS

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ABSTRACT

Criteria for qualitative evaluation of garment appearance quality as the evaluation of garment appearance quality can be done on the basis of the visual appearance of the garment form, reflected as 3D behavior of the fabric built-in, the model for qualitative evaluation of garment appearance quality is constructed on defining the Aesthetic appearance (such as garment drape), Required form - 3D shape of the garment and Quality of the fit. This study aims to determine the influence of seam angles positions on the drape behaviour in terms of drape coefficient, drape nods, nods numbers. For the experimental work four fabrics were sewn with three different stitch types (stitch 301, stitch 504, and stitch 515) in various angles (0°, 30°, 45, 60°, 90°). Results of drape coefficients and nods shape and number were statistically analyzed. Investigating the drape on fabric with seams can improve apparel design and fabric end-use applications.

KEYWORDS: Drape Coefficient, Drape Nods, Nods Number, Seam Angle & Stitch Types

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Original Article

1. INTRODUCTION

Drape is the term used to describe the way a fabric hangs under its own weight. Fabric drapability is an important factor from an aesthetic point of view. The quality of 'drape' is important to a designer as it influences a garment's appearance. The draping qualities required from a fabric will differ depending on its end use, Woven fabrics are stiffer than knitted fabrics, so they are used in tailored clothing where the fabric hangs away from the body and disguises its contours [7].

The assessment and characterization of a textile fabric can be carried out according to various criteria, such as:

- Appearance / optics,
- durability (physical properties),
- Load behavior
- Care behavior and
- Tenacity [5].

The drape behavior belongs to the criteria of appearance and wearing behavior. It is known that the bending stiffness and the shear strength directly influence the drape behavior (drapability) of a fabric. Both material parameters, bending stiffness and drapability, are necessary for the simulation of a clothing product [8].

Drape is defined as the display of a fabric in elegant folds as a result of gravity [9]. It is dependent on

fabric's structure and mechanical properties [4]. Unattractive garment drape occurs when garment seams twist towards the back or front or when nodes (folds) form different shapes on each side of the garment. Pattern pieces positioned incorrectly (not in the fabric grain line) in the marker may cause unwanted garment drape [10].

Various methods and devices have been developed in recent decades to investigate the drape behavior. The CUSICK drapemeter serves as the test device.

The British standard for the assessment of drape of fabrics (BS 5058) [3] describes a method using the 'Drapemeter'. A circular specimen, about 30 cm in diameter, is supported on a circular disk of 18 cm diameter. The unsupported area may drape to form some folds. The number of the folds (nodes) is used to describe the drapability directly. The more the nodes, the softer is the fabric. The drape coefficient is the ratio of the draped area of the fabric sample to its undraped area, in which the area of the supporting disk is deduced.

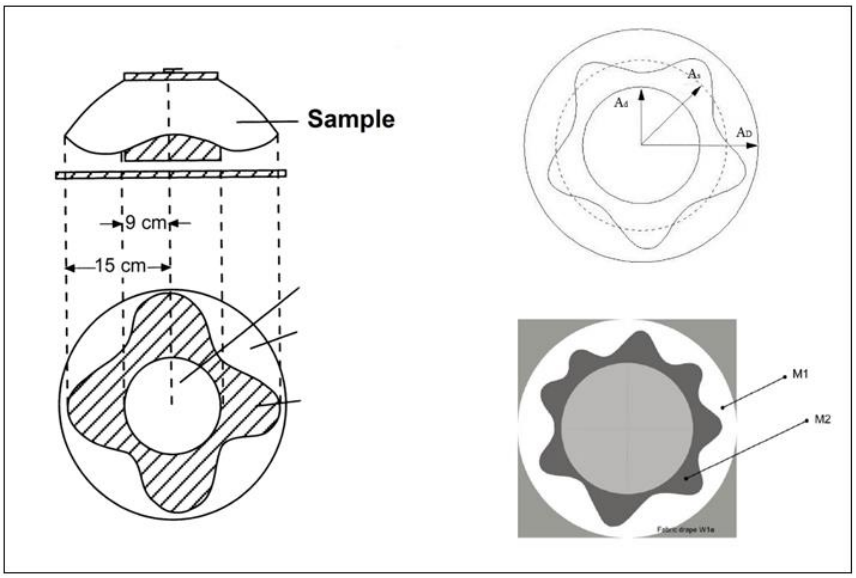


Figure 1: Principles of Calculation the Drape Coefficient.

The area of shadow (A_S) is measured and compared with the area of the sample (A_D) and that of the supporting platform (A_d). The drape coefficient DC is calculated from the equation 1:

$$\text{The Drape coefficient (DC)} = \frac{\text{Are of Shadow } (A_S) - \text{Area of supporting platform } (A_d)}{\text{Area of sample } A_D - \text{Area of supporting platform } (A_d)} \times 100\,\% \quad (1)$$

In the actual test, the light beam casts a shadow of the draped fabric onto a ring of highly uniform translucent paper supported on a glass screen. The surface drape pattern area on the paper ring is directly proportional to the way: mass of shaded area (M_S), total mass of paper ring (M_D). The principles of calculating the DC are presented in figure (1). There are three different standard diameters of specimen that can be used for different fabrics:

- 24 cm for cm limp fabrics, whose drape coefficients are below 30% with the 30 cm sample
- 30 cm for medium fabrics
- 36 cm for stiff fabrics, whose drape coefficients are above 85% with the 30 cm sample [1].

Factors such as fiber content, yarn structure, fabric structure and type of finish affect the drape behaviour.

The drape coefficient DC is calculated from the equation 2 [3]:

$$\text{The Drape coefficient (DC)} = \frac{\text{Mass of shaded area } (M_S)}{\text{Total mass of paper ring } (M_D)} \times 100\ \% \quad (2)$$

Good draping leads to the fitting of a fabric over a surface without undesirable wrinkling or tearing. Measurement of a fabric's drape increase its ability to hang in good curves, The drape coefficient (DC) has been developed to describe the level of drape and drape shape, A lower DC value means the fabric is softer. In other words, the higher the drape coefficient (DC) the stiffer the fabric is [7].

Researchers have been concerned with assessing the behaviour of draped fabrics for a number of years. Many researches deal with analyzing the key properties affecting the drape behaviour [11]. Others interested in analyzing and simulation of the drape nods (folds) [16]. And some of them gave a lot of interest to determine the drape behaviour of seamed fabrics [2], [13], [14], [15]

2. RESEARCH PROBLEM

The drape and bending behaviour of fabric is affected by the seaming process of combining two or more pieces of fabric, because seamed parts of the fabric bend comparatively less than the unseamed parts. Investigation of the impact of a seam on fabric drape performance helps in understanding, evaluation and assurance of the appearance of the final garment. Drape describes the ability of a textile material to orient itself into folds in more than one plane under its own weight. There is a lake of researches deal with the effect of seam angles and directions on the drape behaviour.

3. RESEARCH GOAL

The purpose of this research is to analyze the influence of seam angles on fabric drape parameters, in terms of drape coefficient and drape folds (nods).

4. EXPERIMENTS

For the experiment of four materials, which are different in weave structures (plain weave and twill weave), fabric contents, weight per unit area and fabric density, are used for carrying out the applied experiments. Specifications of chosen materials are shown in table 1.

Seam type SSa with stitch type 301 was used to prepare samples. Six types of samples were prepared with varying number of seams and seam directions for draping test. For the bending testing, six types of samples were prepared with varying fabric direction. Cusick's drapemeter was used as a testing apparatus to analyze the drape of samples with seams. Drape behavior was determined and compared in terms of drape coefficient and node amplitude. The effect of the number of seams and seam directions on fabric drape coefficient and stability of drape profile were statistically determined.

Table 1: Specifications of Investigated Materials

Fabric Code	Fiber Contents	Weave Structure	Weight per Unit Area [gLm2]	Thickness [mm]	Fabric Denisity	
					Warp/ cm	Weft/cm
F 1	98% Wool/2%El	Plain 1/1	154.0	0.29	30	22
F 2	67% PES / 33 Viscouse	Plain 1/1	196.4	0.47	31	22

F 3	49% Viscouse / 49% PES /2% El	Twill 2/2	235.0	0.45	30	22
F 4	55% PES / 45% Wool	Twill 2/1	198.5	0.53	36	26

Seam type SSa with stitch three types of stitches are chosen to prepare samples for experimental work, (lockstitch 301, over lock stitch 504 and safety stitch 515), because they differ in sewing thread consumption and fabric layers number (figure 2). Sewing process was done on industrial sewing machines under particular sewing conditions that are commercially adopted by apparel. The four materials were sewn in with different sewing conditions in different seam angles (0°, 30°, 45, 60°, 90°). For determining the drape behaviour property, size of samples are 30 cm and the samples are cut after sewing, where the seam should be passed cross the sample center. The Patterns for the fabric specimens were drafted in figure (3).

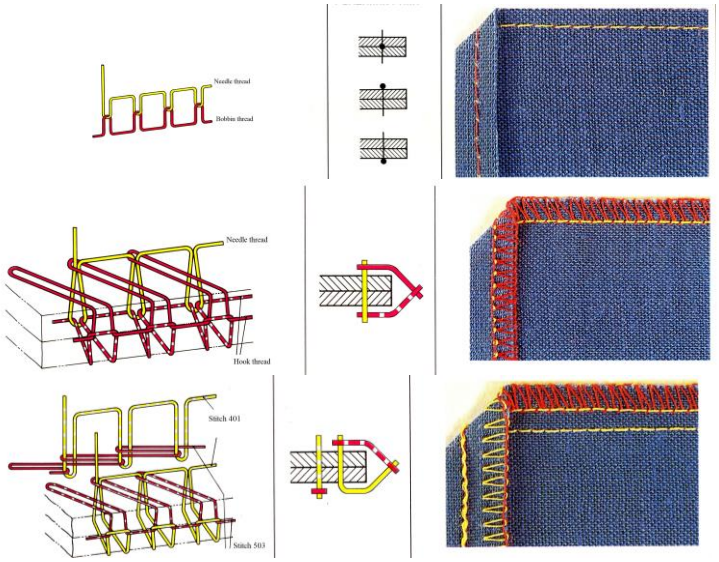


Figure 2: Stich Types for Expriments [6].

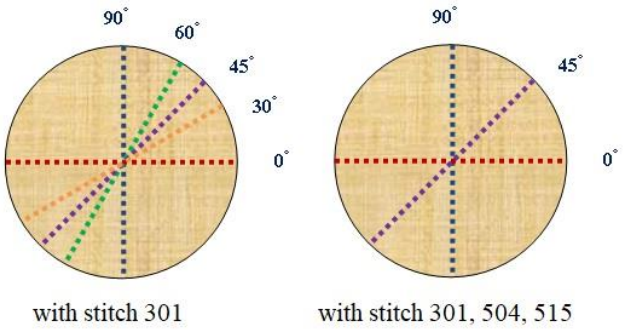


Figure 3: Drape Samples Preparation.

Cusick's drapemeter was used as a testing apparatus to analyze the drape of samples with seams. The drape meter is an optical instrument. It is shown diagrammatically in figure 4. Drape behavior was determined and compared in terms of drape coefficient and node amplitude. The effect of the number of seams and seam directions on fabric drape coefficient and stability of drape profile were statistically determined.

The drape behavior of a textile surface can be determined according to (BS 5058:1973) [3].

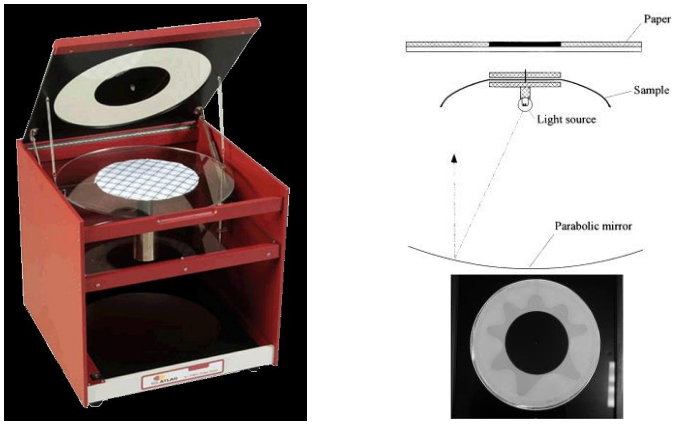


Figure 4: Fabric Drape Tester and the Principles of the Test [12]

5. RESULTS & DISSCUSIONS

Fabric drape is a measured by determining DC using a drapemeter device. However, DC is insufficient alone to describe fabric drape completely. For example, two fabrics have the same DC, but may have differing draped shapes. So, other parameters evaluation of drape characteristics such as number of nodes, node dimensions, drape distance ratio, and drape profile values have been used to explain fabric drape [7].

As described in the literature, drape coefficient can be defined as difference of areas or masses. So first we tested the four unseamed fabrics using the two ways. Table 2 shows these differences.

Table 2: Difference in the Drape Coefficient According two Different Ways

Fabric	DC (Area)	DC (Mass)	Difference (%) $\frac{DC(A) - DC(M)}{DC(A)}$
F 1	0.544	0.502	**6.74 %**
	0.524	0.494	
	0.534	0.498	
Mean	**0.534**	**0.498**	
F 2	0.467	0.426	**7.86 %**
	0.449	0.418	
	0.458	0.422	
Mean	**0.458**	**0.422**	
F 3	0.472	0.436	**7.69 %**
	0.491	0.452	
	0.481	0.444	
Mean	**0.481**	**0.444**	
F 4	0.604	0.584	**5.52 %**
	0.556	0.512	
	0.580	0.548	
Mean	**0.580**	**0.548**	

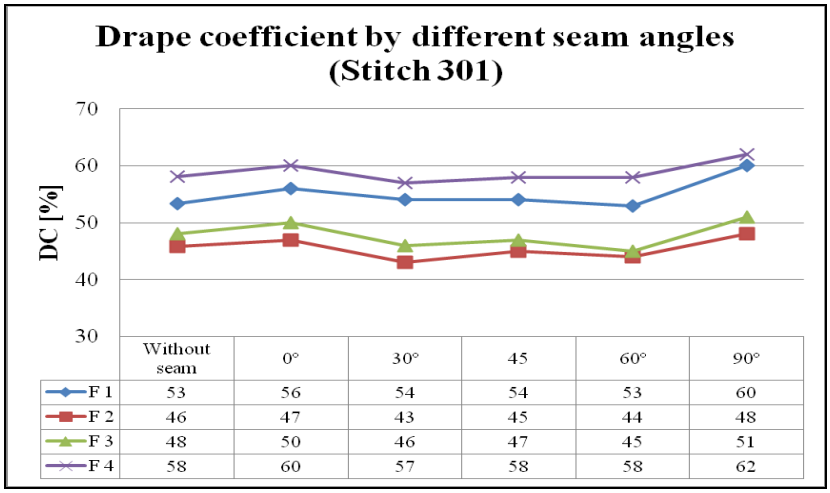
From results in table 2, it is obvious that the calculated DC, which defined with the area, is bigger than DC defined with the mass. The difference is about (5 % to 7 %). That can be refers to the paper cut operation. definitely it was influenced with the manual cut operation.

5.1 Study the Effect of Different Seam Angles on the Drape Behaviour

In order to determine the influence of the seam angle position on the drapeability, the fabric samples are sewn with the

lockstitch 301 in various angular positions (0°, 30°, 45, 60°, 90°) with a seam allowance of 10 mm. The representation of the seam angles is shown in Figure 3.

The analysis of test results in figure 5 shows that the seam generally influences the drape behavior. The drape coefficients of the samples with centrally positioned seams show no stable tendency.



	Without seam	0°	30°	45	60°	90°
F 1	53	56	54	54	53	60
F 2	46	47	43	45	44	48
F 3	48	50	46	47	45	51
F 4	58	60	57	58	58	62

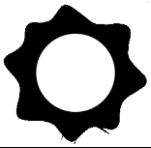
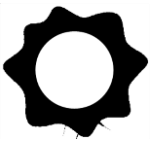
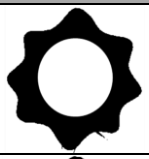
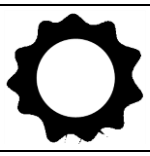
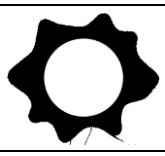
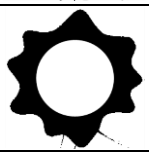
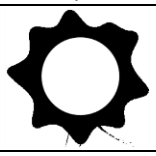
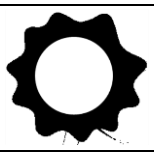
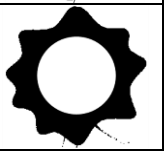
Figure 5: The Drape Coefficient by Various Seam Angles.

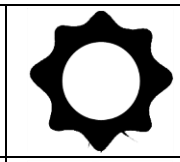
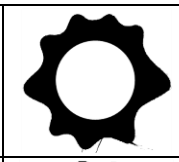
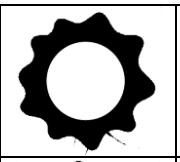
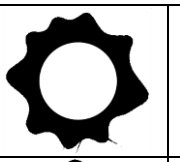
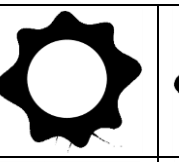
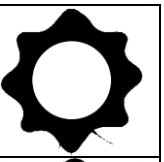
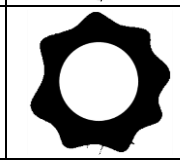
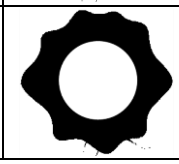
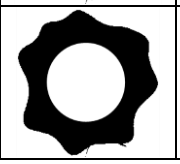
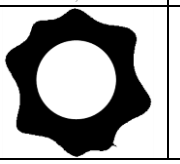
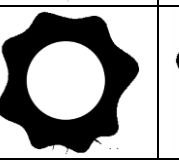
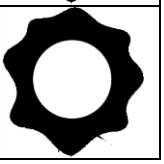
The results make it clear that the change in the seam angle position shows no significant influence on the drape coefficient. The percentage deviation is from 1% to 4%. In general, the values increase partially when the seam is in the warp direction (90 °), since the fabric is usually more rigid due to the weaving process and the seam hits a large number of tie points. The angular position of 30°, 45 ° and 60 ° shows the lowest value of the drop coefficient, since the fabric is more flexible in this direction than in the warp and weft directions and the seam also hits fewer tie points.

Regarding the influence of the seam on the formation of the nods (folds), the seam shows a significant influence on the drape form. The angular position of the seam can be seen in the case pictures since the folds are formed in the direction of the angular position. The drape formation pictures of the samples without seam and with centrally positioned seams (301) in various seam angles are represented in table 3.

The Drape formation shows also that the number of nods (folds) has been affected with the seam. It will be reduced than without seam, for example by fabric 2, the number of nods was 11 nods and very clear folds, but after sewing, the number of nods reduced to a number of 8 to 10 nods. Beside that the nods had unstable shapes.

Table 3: Drape Nods (Folds) in Different Seam Angles (Stitch 301)

Fabric Code	Seam Angles					
	Without seam	0°	30°	45°	60°	90°
F 1						
F 2						

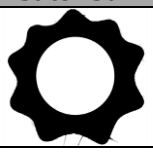
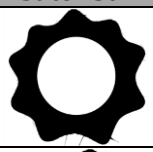
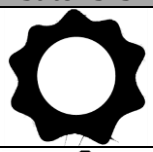
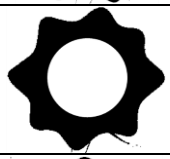
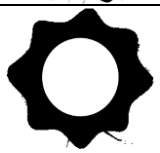
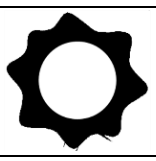
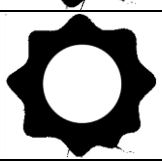
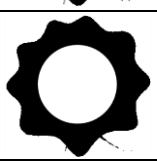
F 3						
F 4						

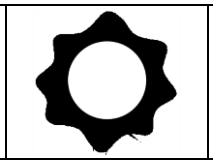
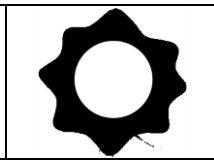
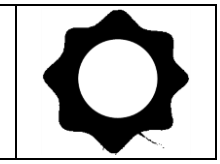
5.2 Drape Behaviour by Different Stitch Types

The aim of this investigation is to determine the influence of the different stitch types on the drape behavior. Three stitch types (double lockstitch 301, overlock chain stitch 504 and safety stitch 515) are selected for the examination. The variation of the angular positions of the lockstitch (301) was examined in the previous section. Since the results showed no great influence of the change in the angular positions, the tests for stitch 504 and stitch 515 can be limited to three possible angular positions (warp direction (90 °), weft direction (0 °) and 45 °).

The results show that the seam generally stiffens the fabric. This stiffening leads to different behaviors. The drape coefficient for stitch type 515 is higher than for stitch types 301 and 505, since the higher the weight and the thicker the seam is, the stiffer the seam and the higher the drape coefficient. The analysis of the results shows that different types of stitches generally influence the drape coefficient. Figures 6, 7, 8, 9 show the different influences of the stitch types on the drape coefficient of the examined materials (F1, F2, F3 and F4). Results confirmed also that the influence of different stitch types on the drape coefficient in different angular positions. The seam in warp direction (90 °) recorded the highest value of drape coefficient. It is repeatedly made clear that the influence of the seam on the formation of the folds is essential. The large folds are formed in the directions of the seams. The folds pictures of four investigated fabrics (F1, F2, F3 and F4) with variants are shown in tables (4, 5, 6 and 7). The drape shapes confirmed again the results that the nods number is reduced with adding the seam.

Table 4: Drape Nods Formation of Different Stitch Types for Fabric 1

Seam angle	Fabric 1		
	Stitch 301	Stitch 504	Stitch 515
Without seam			
0°			
45			

90°			

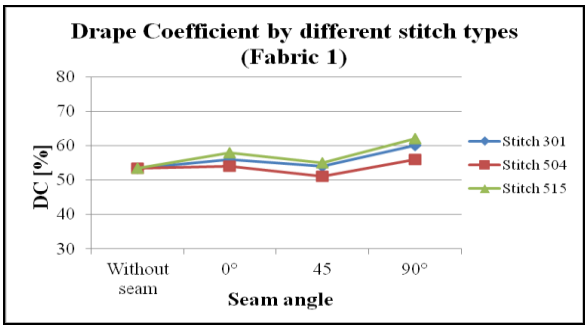
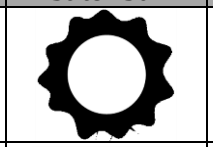
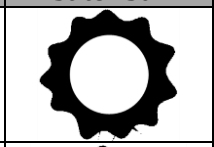
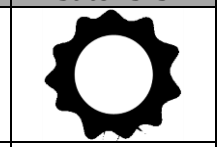
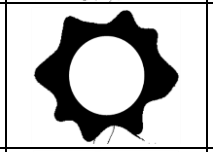
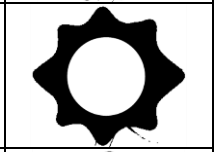
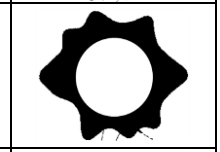
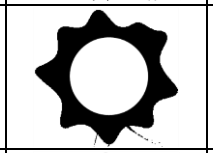
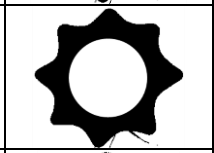
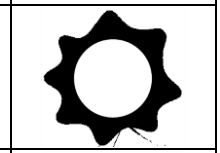
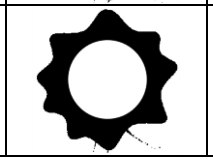
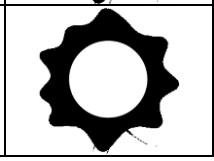
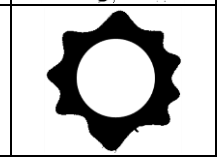


Figure 6: The Drape Coefficient by Different Stitch Types for Fabric 1.

Table 5: Drape Nods Formation of Different Stitch Types for Fabric 2

Seam angle	Fabric 2		
	Stitch 301	Stitch 504	Stitch 515
Without seam			
0°			
45			
90°			

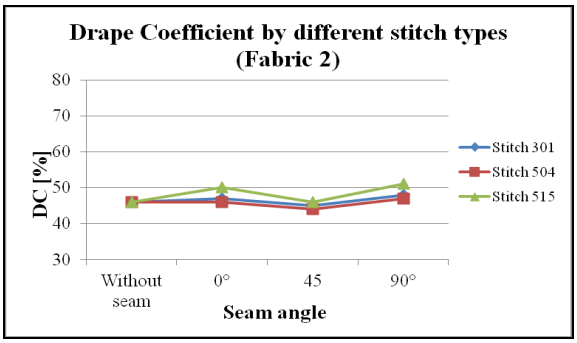
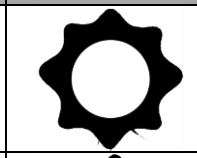
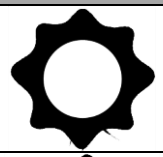
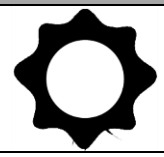
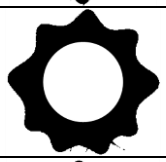
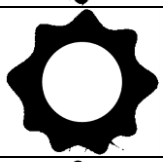
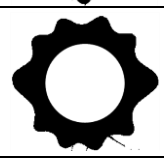
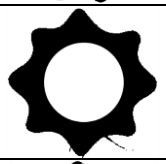
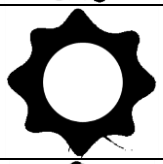
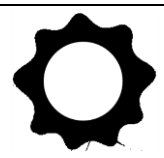
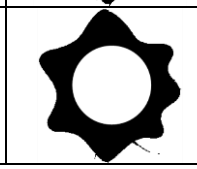
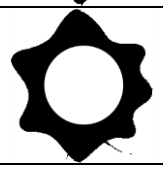
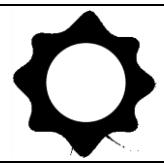


Figure 7: The Drape Coefficient by Different Stitch Types for Fabric 2.

Table 6: Drape Nods Formation of Different Stitch Types for Fabric 3

Seam angle	Fabric 3		
	Stitch 301	Stitch 504	Stitch 515
Without seam			
0°			
45			
90°			

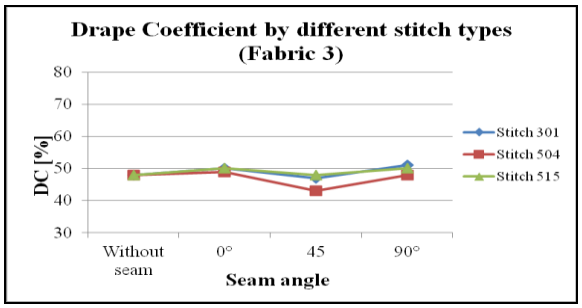
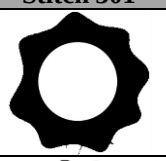
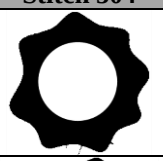
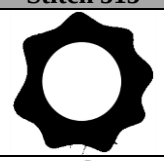
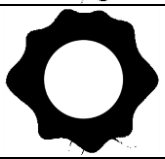
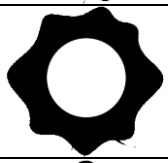
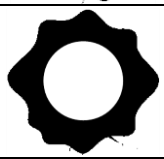
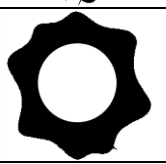
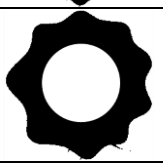
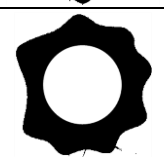
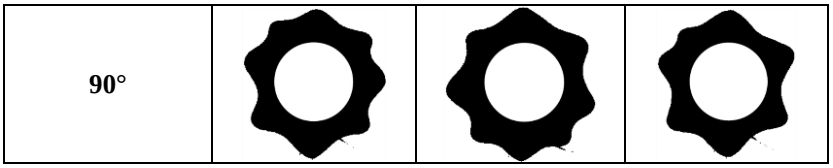


Figure 8: The Drape Coefficient by Different Stitch Types for Fabric 3.

Table 7: Drape Nods Formation of Different Stitch Types for Fabric 4

Seam Angle	Fabric 4		
	Stitch 301	Stitch 504	Stitch 515
Without seam			
0°			
45			



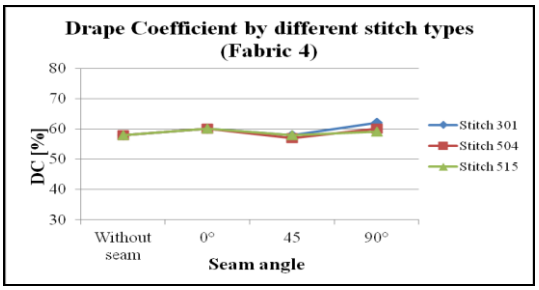


Figure 9: The Drape Coefficient by Different Stitch Types for Fabric 4

6. CONCLUSIONS

Fabric drape is an important element in a garment's overall aesthetic appearance and is one of the most important properties of interest to fabric and apparel buyers.

This research aims to determine the impact of the seam angles on the drape behaviour in terms of drape coefficent and drape nods formation and nods number.

Three stitch types (stitch 301, stitch 504 and stitch 515) were chosen for the investigation. Samples were sewn in different seam angles positions (0°, 30°, 45, 60°, 90°). The drape coefficient for the variants were calculated and explained, otherwise the drape nods shapes were shown and explained. The analysis of test results shows that the seam generally influences the drape behavior. The drape coefficients of the samples with centrally positioned seams show no stable tendency. In general, the values increase partially when the seam is in the warp direction (90°), since the fabric is usually more rigid due to the weaving process and the seam hits a large number of tie points. The angular position of 30°, 45 ° and 60 ° shows the lowest value of the drop coefficient. The drape coefficient for stitch type 515 is higher than for stitch types 301 and 505, since the higher the weight and the thicker the seam is, the stiffer the seam and the higher the drape coefficient. The angular position of the seam can be seen in the drape pictures since the folds are formed in the direction of the angular position. The drape shapes confirmed again the results that the nods number is reduced with adding the seam.

Investigating on drape on fabric with seams can improve apparel design and fabric end-use applications. Moreover, contributing to garment drape prediction for the 3D modeling in clothing CAD system.

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